

**APPLICATION FOR UNITED STATES LETTERS PATENT**

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**TITLE:**      **ELECTRIC WAVE TRANSMITTING AND RECEIVING  
APPARATUS OF PORTABLE TERMINAL**

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# ELECTRIC WAVE TRANSMITTING AND RECEIVING APPARATUS OF PORTABLE TERMINAL

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

[1] The present invention generally relates to wireless communications, and more particularly to an electric wave transmitting and receiving apparatus of a wireless terminal.

### 2. Background of the Related Art

[2] An antenna used in a portable terminal (e.g., a cellular phone) includes a vertical polarization antenna installed at an outer side of the terminal body and a circular polarization antenna mounted at a printing circuit board. These antenna are used for transmitting and receiving audio and data.

[3] In a cellular phone, a signal amplified by a high frequency circuit therein is converted into electromagnetic waves through an antenna, which may badly influence a user's brain adjacent the antenna. As the number of cellular phone users increase, arguments in support of the theory that these waves are harmful to the human body increase.

[4] Figure 1 is a lateral view showing a portable terminal in accordance with the related art, and Figure 2 is a lateral view showing a vertical polarization antenna of a portable terminal in accordance with the related art. The related-art portable terminal comprises: a body 10; a folder 20 hinge-coupled at an upper portion of the body 10 for opening and closing; a chargeable battery 30 attachably and detachably coupled at a rear surface of the body 10; and an antenna 40 coupled at an upper surface of the body 10 for transmitting and

receiving an electric wave. The antenna 40, as shown in Figure 2, includes an antenna line 42 of a coil shape installed within a radome 41, and a fixed screw 43 installed at a lower portion of the antenna line 42 to be electrically connected. By screw-engaging the fixed screw 43 of the antenna 40 to the body 10, the antenna is electrically connected to a printing circuit board (not shown). Also, a circular polarization antenna (not shown) is mounted at one side of the printing circuit board.

[5] In the related-art portable terminal, the vertical polarization antenna is located adjacent to the user's head during a call and is fixed in a constant direction. It is therefore difficult to control a position or a direction of the vertical polarization antenna and thus to prevent an electromagnetic wave from harming the user.

[6] Also, the circular polarization antenna is mounted in the body, that is, in the printing circuit board. In this position, sensitivity for transmitting and receiving calls is lowered.

## SUMMARY OF THE INVENTION

[7] An object of the present invention is to solve one or more problems of the related-art terminal described above.

[8] Another object of the present invention is to provide a wireless terminal which includes an electric wave transmitting and receiving apparatus that minimizes the harmful influence of electromagnetic waves on a user's body by making an antenna of the terminal rotate at a certain angle when a folder of the terminal is opened for calling.

[9] Another object of the present invention is to provide a wireless terminal which includes an electric wave transmitting and receiving apparatus that increases a receiving sensitivity by exposing not only a vertical polarization antenna but also a circular polarization antenna to the outside of a body.

[10] To achieve these and other objects and advantages, the present invention provides an electric wave transmitting and receiving apparatus of a portable terminal comprising: a rotating member axially installed in a mounting groove formed at an upper portion of a body to be rotated with a certain angle; a vertical polarization antenna installed at an upper of the rotating member, for rotating the rotating member around the axis by a pressure of a folder at the time of opening the folder of the portable terminal; an elastic member installed at one side of the rotating member, for placing the rotated vertical polarization antenna and the rotating member to original positions; a vertical polarization antenna connector for connecting the vertical polarization antenna to a printing circuit board mounted in the body; a circular polarization antenna installed at a side surface of the rotating member; and a circular polarization antenna connector for connecting the circular polarization antenna to the printing circuit board.

[11] The vertical polarization antenna connector includes: a vertical polarization antenna feeder line installed at an outer circumference surface of the rotating member in a contacted state with the vertical polarization antenna, and a vertical polarization antenna feeder line elastic supporting portion elastically installed at one side of the printing circuit board in a contacted state with the vertical polarization antenna feeder line.

[12] The circular polarization antenna connector includes: a circular polarization antenna feeder line extendedly installed at an outer circumference surface of the rotating member in a contacted state with the circular polarization antenna, and a circular polarization antenna feeder line elastic supporting portion elastically installed at one side of the printing circuit board in a contacted state with the circular polarization antenna. The circular polarization antenna feeder line penetrates an axial hole formed at a center of the rotating member, and is installed at an outer circumference surface of the rotating member in a longitudinal direction.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[13] Figure 1 is a lateral view showing a portable terminal in accordance with the related art;

[14] Figure 2 is a lateral view showing an antenna of a portable terminal in accordance with the related art;

[15] Figure 3 is a perspective view showing an electric wave transmitting and receiving apparatus of a portable terminal according to the present invention;

[16] Figure 4 is a sectional view taken along line A-A of Figure 3;

[17] Figure 5 is a perspective view of an extracted main part for explaining a vertical polarization antenna feeder line and a circular polarization antenna feeder line of Figure 3;

[18] Figure 6A shows a side view of the terminal of the present invention in a closed-folder state, and Figure 6B is an exploded view showing a contact state of a vertical

polarization antenna feeder line and its elastic supporting portion in the closed-folder state in accordance with the present invention;

[19] Figure 7A shows a side view of a terminal of the present invention in a closed-folder state, and Figure 7B is an exploded view showing a contact state of a circular polarization antenna feeder line and its elastic supporting portion in the closed-folder state in accordance with the present invention;

[20] Figure 8A shows a side view of the terminal of the present invention in an open-folder state, and Figure 8B is an exploded view showing a contact state of a vertical polarization antenna feeder line and its elastic supporting portion in the open-folder state in accordance with the present invention; and

[21] Figure 9A is another side view of the terminal of the present invention in an open-folder state, and Figure 9B is an exploded view showing a contact state of a circular polarization antenna feeder line and its elastic supporting portion in the open-folder state in accordance with the present invention.

#### **DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS**

[22] Referring to Figures 3 and 4, a portable terminal in accordance with one embodiment of the present invention includes a folder 102 hinge-coupled at an upper portion of a body 101 for opening and closing. A mounting groove 101a is formed at the upper portion of the body at a part where the body and the folder are hinge-coupled. An upper portion of the mounting groove 101a is opened, and a lower portion thereof is connected to a printing circuit board P inside the body.

[23] An insulation axis 103 is installed in the mounting groove 101 in a horizontal direction, and a rotating member 104 is installed on the axis 103 with a horizontal cylindrical shape. More specifically, a circular polarization feeder line 111 which will be later explained is installed at an inner circumferential surface of an axial hole 104a formed at a center of the rotating member 104, and the axis 103 is inserted into the axial hole 104a. The axis is preferably formed of an insulating material only, in order to rotate the rotating member 104. In this arrangement, the rotating member 104 rotates around axis 103.

[24] A vertical polarization antenna 105 is fixed at an upper surface of the rotating member 104. When a user opens folder 102 of the portable terminal for calling, the vertical polarization antenna 105 is pressed in a backward direction by the folder 102. The force provided by the folder causes the rotating member 104 to rotate a certain angle pointing away from the user's head. In order to make the vertical polarization antenna 105 smoothly rotate as folder 102 presses the vertical polarization antenna 105 backwards, a push protrusion 102a is preferably extendedly formed at one side of an upper portion of the folder 102 in alignment with antenna 105.

[25] A tension spring 106 is also preferably included for placing the vertical polarization antenna 105 and the rotating member 104 back to their original positions when the user closes the folder 102 after calling is terminated. As shown, the tension spring may be installed adjacent a side surface of the rotating member 104. One end of the tension spring 106 is fixed on a stopping protrusion 107 formed at the side surface of the rotating member 104, and the other end of the spring is fixed on a bottom surface of the mounting groove 101a, that is, one side of the body 101.

[26] Referring to Figure 5, a helical antenna line 105b of a coil form is installed within a radome 105a of the vertical polarization antenna 105. A lower portion of the helical antenna line 105b is connected to the vertical polarization antenna feeder line 108 formed along an outer circumferential surface of the rotating member 104 in a longitudinal direction.

[27] A vertical polarization antenna feeder line elastic supporting portion 109 elastically mounted at the printing circuit board P is preferably always in contact with a lower portion of the vertical polarization antenna feeder line 108. Even though the rotating member 104 is rotated around the axis 103, the vertical polarization antenna feeder line elastic supporting portion 109 maintains an elastic contact state with the vertical polarization antenna feeder line 108.

[28] A circular polarization antenna 110 for transmitting and receiving circularly polarized signals is installed at one side of the rotating member 104. The circular polarization antenna 110 is connected to the circular polarization antenna feeder line elastic supporting portion 112 elastically installed at the printing circuit board P by the circular polarization antenna feeder line 111. A structure of the circular polarization antenna feeder line 111 will be explained as follows.

[29] First, the circular polarization antenna feeder line 111 is inserted into axial hole 104a at one side of rotating member 104 while being connected to the circular polarization antenna 110, formed at side surface of the rotating member 104, and installed at an inner circumference surface. Then, the circular polarization antenna feeder line 111 is carried out to the axial hole 104a of the other side of the rotating member, and then extended to a side surface, a lower surface, and an outer circumference surface of the

rotating member 104. At this time, the circular polarization antenna feeder line 111 is installed at an outer circumference surface of the rotating member 104 in a parallel state to the vertical polarization antenna feeder line 108.

[30] The vertical polarization antenna 105 transmits and receives an electric wave to the printing circuit board P through the helical antenna line 105b, the vertical polarization antenna feeder line 108, and the vertical polarization antenna feeder line elastic supporting portion 109. Also, the circular polarization antenna 110 transmits and receives an electric wave to and from the printing circuit board P through the circular polarization antenna 110, the circular polarization antenna feeder line 111, and the circular polarization antenna feeder line elastic supporting portion 112.

[31] Operation effects of the transmitting and receiving apparatus of the portable terminal according to the present invention are as follows.

[32] As shown in Figures 6A and 6B, in an initial state, the vertical polarization antenna 105 is vertically positioned when the folder is closed. The vertical polarization antenna feeder line elastic supporting portion 109 is elastically (e.g., spring-biased) in contact with the vertical polarization antenna feeder line 108. Arranged in this manner, an electromagnetic wave generated from the vertical polarization antenna 105 is transmitted to the printing circuit board P through the vertical polarization antenna feeder line 108 and the vertical polarization antenna feeder line elastic supporting portion 109.

[33] As shown in Figures 7A and 7B, the circular polarization antenna 110 is installed at a side surface of the rotating member 104 and the vertical polarization antenna feeder line elastic supporting portion 112 is elastically in contact with the circular

polarization antenna feeder line 111. Arranged in this manner, an electromagnetic wave generated from the circular polarization antenna 110 is transmitted to the printing circuit board P through the circular polarization antenna feeder line 111 and the circular polarization antenna feeder line elastic supporting portion 112.

[34] As shown in Figures 8A and 8B, when user opens folder 102 of the terminal for calling, the vertical polarization antenna 105 is pressed back by push protrusion 102a of the opened folder 102. At this time, the rotating member 104 to which the vertical polarization antenna 105 is fixed is rotated around axis 103 to a certain angle in a backwards direction and away from the user's head.

[35] As shown in Figures 9A and 9B, the vertical polarization antenna feeder line elastic supporting portion 109 and the circular polarization antenna feeder line elastic supporting portion 112 are respectively in contact with the vertical polarization antenna feeder line 108 and the circular polarization antenna feeder line 111. As a result, an electromagnetic wave generated from the vertical polarization antenna 105 is transmitted to the printing circuit board P through the vertical polarization antenna feeder line 108 and the vertical polarization antenna feeder line elastic supporting portion 109. Also, an electromagnetic wave generated from the circular polarization antenna 110 is transmitted to the printing circuit board P through the circular polarization antenna feeder line 111 and the circular polarization antenna feeder line elastic supporting portion 112. Therefore, transmission and reception of signals can be smoothly performed while the antenna 105 is in its retracted position.

[36] More specifically, in this position the vertical polarization antenna 105 is apart from the user's head and maintains a certain angle at the time of calling, thereby minimizing harm to the user due to electromagnetic waves generated at the time of the calling. Also, the circular polarization antenna 110 is preferably exposed to an outside portion of the body 101, thus enhancing transmission and reception sensitivity.

[37] In summary, the vertical polarization antenna 105 is constructed to be rotated in a backwards direction to a certain angle when folder 102 is opened for calling. In this position, the vertical polarization antenna 105 is apart from the user's head and maintains a certain angle at the time of calling, thus minimizing harm to the user from electromagnetic waves generated at the time of the calling. Also, the circular polarization antenna 110 is constructed to be exposed to outside of the body 101, to enhance transmission and reception sensitivity.

[38] As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalence of such metes and bounds are therefore intended to be embraced by the appended claims.